

India could harness public-private partnerships to achieve malaria elimination

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Summary

Public-private partnerships (PPP) have been beneficial in different sectors like infrastructure development and service sector across the world, including in India. Such partnerships in the healthcare sector have also been successful in providing access to affordable medical attention to all sections of society. These partnerships between public and private entities have proven to be beneficial in controlling malaria in high burden districts of India and taking these areas to the brink of elimination, thus setting examples to follow. The two successful ones are the Comprehensive Case Management Project (CCMP) in Odisha which is now adopted by the state, and the Malaria Elimination Demonstration Project (MEDP) which has nearly eliminated malaria from the highly endemic district of Mandla in Madhya Pradesh. Here we propose that non-government and semi-government actors may be given vital roles in the malaria elimination efforts till 2030 and beyond. These partners will add value to the national programme and may have the potential to develop and test different models of malaria elimination in real-life settings that the government programme can absorb sustainably.

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Introduction

Public and private sector partnerships are envisaged as complementary relationships that draw from each other's unique characteristics and strengths. These public-private partnerships (PPP) entail investments, responsibilities, risks and rewards among the partners. Establishing such partnerships includes access to high-level expertise, modern technologies, innovative financing, modern design, maintenance of public infrastructure and elevating services to high standards. The government of India defines a public-private partnership as an arrangement between a government body and the private sector to provide services or infrastructure via involvement of private sector in investments or management or both.¹ Payments to the private sector can be linked to performance.² These partnerships are viewed as mechanisms for the government to best use the public infrastructure and/or services with the support of resources and expertise of the private sector.³ Government organizations gain from the expertise of the private sector. Via the delegation of work responsibilities to different partners, the government bodies can

concentrate on policy and planning issues. There are ~ 2000 PPP projects in India that are ongoing or completed in various sectors such as railways, water, health, roadways, electricity, health and others.² There are several models of PPP, for instance, user fee-based Build Operate Transfer model, performance-based maintenance contracts, modified design-build contracts and others.³

Public-private partnership in Indian healthcare system

It is increasingly recognized that public-private partnerships can play a significant role in the healthcare sector in India. Public-private partnership (PPP) as a vehicle to deliver healthcare services is being incorporated as a component in the policy landscape.⁴ Government of India's think tank, the National Institution for Transforming India (NITI) Aayog, has also flagged the need to launch small-scale studies in PPP mode to enhance the availability and quality of healthcare services.^{4,5} For the past several decades, the private sector has incrementally expanded its scope and terrain in the health sector and now contributes >70%.⁶ According to the National Health Policy of India (2017) ~2.5 percent of Gross Domestic Product (GDP) must be spent on the

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health sector by 2025. The expenditure on health was ~1.8% of GDP in 2020-21 and rose to ~2.1% in 2021-22.⁷ PPP is visualized as an alternative to improving the delivery of healthcare to communities due to following reasons: first, PPP can be a platform to bring in private sector expertise and their management skills to complement the resources available in public sector space; second, a large proportion of population including the poorest avail private healthcare services due to variety of reasons. These include perception of better quality treatment, shorter waiting periods and thus averted loss of wages, ease of access, less documentation (preferable for migrant workers), immediate treatment and flexible payment options.

There is a recognition that since the large private sector already exists and continues to grow, it is pragmatic that the relationship between the private healthcare sector and public health sector be fostered. There are several models of PPP focusing on health infrastructure development, mobilizing resources, and augmentation of services. The various healthcare models functional in India are contracting-in, contracting-out, voucher system, mobile health vans, insurance, subsidies, leasing or rentals, and privatization.

Public-private-partnership and malaria elimination by 2030

India continues its fight against malaria amid the ongoing Covid-19 pandemic. World Health Organization estimated 241 million malaria cases and 558,000 deaths due to malaria in 85 malaria-endemic countries in 2021.⁸ India contributed 5 million estimated cases to the overall number of cases as per World Health Organization's World Malaria Report 2021 (WMR 2021). In terms of absolute numbers, India's caseload decreased from about 20 million cases (2000) to around 4.1 million (2020), although it made up for 83% of malaria cases and 82% of deaths in Southeast Asia.⁸ As per the epidemiological data reported by the national malaria control programme, there were 158,326 cases and 80 deaths in the country in 2021.⁹⁻¹⁰ In the same year (2016), the Ministry of Health and Family Welfare (MoHFW) pledged to eliminate malaria by 2030. It launched National Framework for Malaria Elimination, shifting the gears from control strategies to elimination.¹¹

Currently, malaria as a vector borne disease is primarily the responsibility of the National Centre of Vector Borne Disease Control (NCVBDC) under the Ministry of Health and Family Welfare, Government of India. To optimize the resources, horizontalization of health services was carried out, and the vertical national malaria control programme was integrated with general health services, known as the National Health Mission in 2005. For a vast country like India, with a population of 1.3 billion and more than 720 malaria endemic districts, the national programme in its National

Framework for Malaria Elimination (2016-2030) flagged a shortage of skilled manpower in all facets of malaria control as a challenge to the achievement of malaria elimination.¹¹

The private healthcare sector has always played a significant role in imparting health care to the Indian population, including healthcare services for malaria control and treatment. It is estimated that ~70% of population uses private healthcare sector in India. Proliferation of this sector may be due to several complex reasons that are beyond the scope of this paper. Studies in malaria endemic areas have revealed people's preference for private healthcare services. In a survey carried out in malaria endemic districts of Assam, initial choice of treatment seeking for febrile illness was private healthcare facility for more than half (~53%) of the participants.¹² Similarly, in malarious areas of Mizoram state of India, more than half (60%) respondents informed that they went to private sector for their healthcare needs. The common reasons cited were proximity (68%), lack of diagnostic facilities and perception of better treatment quality in government facilities (46%).¹³ Singh et al reported similar findings on malaria treatment seeking predilections from four malaria endemic districts of Madhya Pradesh, Central India.¹⁴

In the context of above scenarios, there is an urgent need for active participation and collaboration of the private sector in a formalized way via public-private partnership models in response to the goal of malaria elimination by 2030.¹⁵ There are various avenues and dimensions of malaria elimination programme where the private sector can productively partner with the national malaria programme.

The PPPs will enhance India's malaria elimination drive. The private sector can add financial resources, trained workforce, technical expertise, incentive and disincentive linked performances, robust monitoring frameworks and multiple reviews for mid-course corrections if needed.

Table 1 describes worldwide examples where private organizations have catered to some aspect of malaria as a disease and its control like providing free-of-cost nets or drugs or serving to a certain section of the population. In the given examples, the nature of private partners ranges from companies and industries to consortia and not-for-profit organizations like GFATM (Global Fund to fight AIDS, Tuberculosis and Malaria), pharmaceutical companies and others. Many partnerships have been fruitful in pushing the agenda of malaria elimination in several countries and India can emulate these valuable lessons from successful countries.¹⁶ For instance, the involvement of Tropical and Environmental Diseases and Health Associates Private Limited (TEDHA) in 2010-2014 in Sri Lanka's programme of elimination of malaria in post-war circumstances has been excellent. The organization was involved in various facets of malaria control such as epidemiological

Country	Year	Private sector	Component of malaria control programme	Impact
Sri Lanka ¹⁷	2010-14	Tropical and Environmental Diseases and Health Associates Private Limited (TEDHA)	Intensified human and vector surveillance, web-based case based health information system, capacity building, tracking populations, community mobilization, monitoring and evaluation.	Feasibility of a successful PPP model in war affected Sri Lanka. Robust level of screening of vulnerable people in receptive areas.
Ethiopia ³⁸	2009-15	USAID funded Private Health Sector Programme (PHSP)	110 private healthcare facilities involved in malaria care services	Case management improvement
Seven countries (Ghana, Kenya, Madagascar, Niger, Nigeria, Uganda and Tanzania) ¹⁸	2010	Affordable Medicines Facility malaria (AMFm) established by GFATM	Access to affordable quality assured ACT medicines by price negotiations with manufacturers, co-payments, subsidized medicines, training of private sector vendors, communication with communities	Substantial increase in availability and market share. Subsidy a 'gamechanger' in provision of quality drugs.
Lao PDR ³⁹	2008	Public Private Mix initiative involving both government and private health sector	Diagnosis and treatment by registered private pharmacies and private clinics in 14 districts of 4 provinces	Provision of quality assured RDTs to private pharmacies and rise in number of malaria cases reported.
Tanzania ⁴⁰	2001-06	The Tanzania National Voucher Scheme	Subsidy scheme for Insecticide Treated Nets (ITNs) for pregnant women and infants	Led to high coverage of nets and development of hybrid mechanism in the strategic plan 2008-13.
Mali ³⁸	2005	Mining company	Indoor residual Spray (IRS), larval source management, larvicides education of communities	70% drop in malaria cases
Ghana ^{39,40}	2005	AngloGold Ashanti	Integrated malaria control programme	Successfully reduced cases in mining community
Sub-Saharan African countries ¹⁸	2004	DNDI-Sanofi aventis development partnership	Development of a non-patented FDC of artesunate amodiaquine (ASAQ) by passing lengthy procedures	ASAQ Winthrop prequalified by WHO in 2008, registered in 20 Sub-Saharan African countries and India.
Zambia ⁴⁴	2003	Mining company	Indoor residual Spray (IRS), malaria case management, Intermittent Preventive Treatment of malaria for Pregnant Women (IPTp), education and behaviour change communication	Reduction in malaria and increased productivity
Equatorial Guinea ⁴⁵	2002	Marathon Oil Corporation	IRS and bednets to the staff, free of cost ACT to children and pregnant women, IPTp, training, mobilization campaign	Decrease in malaria incidence among its worker population and nearby villages
Uganda and Kenya ⁴⁶	1999-2001	Malarone Donation Programme by GSK	Donation of one million treatment courses of malarone annually	Initial positive impact in pilot studies but deemed unsustainable. Discontinued after pilot phase.
Philippines ⁴³	1999	Pilipinas Shell Foundation, Inc.	IRS, ITN distribution, diagnosis and treatment Services and training	92% reduction in malaria cases between 2005 to 2018
Brazil ⁴³	1990s	Mining company	Detection and treatment of cases, provision of vector control tools and equipment	Reduction in cases and deaths
Chad, Cameroon ⁴⁷	1990s	ExxonMobil, Petronas, Chevron	Provision of ITNs and chemoprophylaxis	Community outreach programme contributing to overall health improvement.
Malaysia ⁴⁸	1990s	Plantation companies	On-site case management, ITNs and IRS coverage	Reduction in malaria cases, absenteeism, employee health cost, enhanced productivity.

Table 1: Examples of countries which have utilized public-private partnerships in malaria control and its impact.

and entomological surveillance, capacity building, and development of health information systems.¹⁷ Similarly, Affordable Medicines Facility-malaria (AMFm), founded by GFATM in 2010 in eight countries (Cambodia, Ghana, Kenya, Madagascar, Niger, Nigeria, Uganda, and Tanzania), aimed to improve access to affordable quality-assured artemisinin-based combination treatment (ACT) medicines by price negotiations with manufacturers, co-payments, subsidized medicines, training of vendors and communication with communities. This experiment led to a substantial increase in availability and market share of subsidized artemisinin-based combination therapies. The subsidy was seen as a 'gamechanger' which acted as a catalyst in the provision of quality-assured medicines.¹⁸ Another noteworthy example of such a coalition is in the field of co-development of ACT artesunate and amodiaquine (ASAQ) in a fixed-dose combination (FDC) by Sanofi-aventis and DNDi in 2004 to fast track a patient-friendly (especially for children) and affordable FDC. Between 2004 and 2007, Sanofi-aventis and DNDi partnered to expedite the processes of licensing of ASAQ.

Sanofi-aventis gave up patent rights in line with the DNDi's intellectual property policy of developing drugs as public goods and making effective drugs available to the neediest. The drug combination was WHO pre-qualified in 2007 and registered in 30 African nations between 2006 and 2010.¹⁹ The collaboration demonstrated the power of partnerships that brings together different sets of strengths and skills to address the challenges of poverty-related diseases like malaria.

Case studies of successful Public-Private Partnerships from India in malaria elimination

Here we describe two examples as case studies from India. First, wherein the lessons learned from the research-cum-intervention projects have now been incorporated into the state policy and programme for malaria elimination. Second example is a malaria elimination demonstration project using the routine programmatic tools with additional components which have yielded success.

Comprehensive Case Management Project (CCMP) and Durgama Anchalare Malaria Nirakaran (DAMaN)

Odisha was a high burden state for malaria and it contributed ~41% of cases in 2016 which steadily declined to 16.1% in 2021.^{10,11} There was a decline in the malaria burden from 2011 to 2013 due to intensified efforts in 2007 via Odisha Health Sector Plan supported by Department for International Development (UK). However, the gains were reversed, and in 2014 the cases exceeded the 2009 levels prompting the state government to think of a revamp plan. The Comprehensive Case Management Project (CCMP) was a unique

collaborative partnership between Government of Odisha, the ICMR-National Institute of Malaria Research and the Medicines for Malaria Venture (MMV). MMV is a not-for-profit public-private partnership established as a foundation in Switzerland in 1999 with the aim to reduce the burden of malaria in endemic countries by discovering, developing and facilitating delivery of new, effective and affordable antimalarial drugs.²⁰ MMV financially and technically supported this PPP model that was launched in 2013. CCMP focused on bolstering surveillance and improving case management by prompt diagnosis and timely provision of treatment with antimalarials.

The premise of the proposed intervention was that strong case management is essential to 'treat the sick', and to shorten the duration of illness thus reducing the odds of continued transmission. It was a quasi-experimental study covering ~0.9 million population with intervention and control blocks spread out in four districts in different (low, medium, high, and hyperendemic) transmission settings and within the existing vector control interventions. CCMP was deployed within the existing healthcare and state programme, building upon health facilities available under the national programme for malaria elimination.^{21,22}

The major interventions were improvement in supply chain management to ensure a continuous supply of drugs and rapid diagnostics, additional quality microscopy centers at the Primary Health Care (PHC) level, training of healthcare staff, supportive supervision of Accredited Social Health Activists (ASHAs) and other community workers, additional supervisory staff, improved case reporting, surveillance via District Health Information Software 2 (DHIS 2) and individual patient treatment cards. Another significant intervention was the identification and enhanced access to difficult-to-reach hamlets (which harbored malaria hot spots with high transmission intensity) and the provision of additional grassroots workers (ASHA-plus) to these areas. Also, mass screening was carried out to detect the hidden burden of asymptomatic malaria in these poorly accessible areas. The CCMP led to better access to early diagnosis and treatment, detection of a large number of asymptomatic cases, and improved case management during the intervention period from 2013-2016. There was a decline of 47% between pre and post-intervention in average monthly positive cases per sub-center from 2013 (preintervention) to 2018 (post-intervention) at the same level of blood examination rate.²³

Thus CCMP demonstrated the immense value addition of operational research spearheaded by state programme with the pre-requisite political will and technical support of research organizations. The results were recognized at national and international fora and CCMP activities like targeted mass screening and treatment of asymptomatic cases became part of the National Strategic Plan (2017-22). The WHO too lauded the efforts

of the Odisha government and the partners. The success of CCMP has been widely acknowledged.^{23,24} Encouraged by the drastic decline in malaria burden, the CCMP (called a 'living laboratory') findings were adopted into a state government led programme—*Durgama Anchalare Malaria Nirakaran* (DAMaN) translated as *malaria elimination in hard-to-reach villages* within high endemic areas in 2017.^{22–24} DAMaN adopted the CCMP approach of mass screening and treatment using bivalent rapid diagnostic tests (RDTs) to detect and treat asymptomatic cases, thus decreasing the reservoir of infection from the population. Vector control tools in form of distribution of insecticide impregnated bednets was an added component in DAMaN which was absent in CCMP. The DAMaN initiative was deployed in 23 high malaria burden districts (7000 remote villages) targeting 1 million population per year from ~6000 camps. Camps were conducted during transmission season (April to May), post-monsoon period (September–October), and additionally in January–February (in some areas). As a result, the reduction of malaria between 2018 and 2019 was ~40% for Odisha against the national average of ~17% during the same period. And malaria cases reported from Odisha reduced to ~25K cases in 2021 from ~40K cases in 2019. The total reduction in malaria in DAMaN districts from 2017 to 2020 was 88%.

The focus of the CCMP was augmenting patient access to quality malaria diagnosis and treatment, especially in the remote, hard to reach areas. The success of the CCMP was evident by the sharp decline in malaria during the five year project period (2013–2018). The factors which led to the success of the project included detailed situational analysis which highlighted the gap areas for access to malaria diagnosis and treatment. The communities living in far flung areas did not have access to malaria diagnosis and treatment and these areas were identified as hot spots. A need to augment the grassroots level workers with skills and extra manpower was also felt. The critical interventions were provision/ensuring of rapid diagnostic tests and drugs to the health care workers, maintaining buffer stock, and trainings of frontline staff leading to improved quality of management. Mass surveys and thus clearing of reservoirs and use of DHIS2 also transformed surveillance. The close collaboration of the state government, NIMR and MMV led to a successful demonstration of malaria control in high endemic blocks of Odisha. Due to improvements in screening and diagnosis, the case detection rate was high from 2013–16 and subsequently came down from 2016–18. Due to the inaccessibility of areas, there were operational and logistic challenges which were overcome via efficient planning.^{22,23}

The Odisha success story is an exemplary example of learnings of public-private partnership (in the form of CCMP) getting translated into a state-funded public health programme towards malaria elimination.

Malaria Elimination Demonstration Project (MEDP)

States of Andhra Pradesh, Chhattisgarh, Gujarat, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan and West Bengal support >80% of indigenous population. The majority of malaria cases (80%) are reported from these states too. Madhya Pradesh is malaria endemic and its Mandla region is a predominantly tribal district with a high incidence of malaria.²⁵

As a model of public-private partnership, similar to DAMaN, Sun Pharmaceutical Industries Ltd. -the largest pharmaceutical company in India²⁶ -collaborated with National Institute of Research in Tribal Health (NIRTH) and Government of Madhya Pradesh, through corporate social responsibility. It partnered with government entities to work towards elimination of malaria in a high endemic district of Madhya Pradesh with its own demographic and access challenges. Mandla, a predominantly tribal district with 1233 villages and 3901 malaria cases in 2015, was the target area for the demonstration of malaria elimination and prevention of re-establishment known as the Malaria Elimination Demonstration Project (MEDP). The project used Track, Test, Treat, and Track (T4) strategy for malaria surveillance which is a modification of the WHO T3 strategy *i.e.*, Track, Test, Treat. The main interventions under the study were strengthening surveillance and case management by deploying additional well-trained grassroots workers and supervisory staff. Active surveillance was bolstered up by house-to-house visits and detection of malaria using rapid diagnostics every 1–2 weeks. An agile system of reporting via regular updates and a mobile app was used. RDT, microscopy and Polymerase Chain Reaction (PCR) tests were conducted on the samples collected from the malaria patients. The project staff monitored and assessed vector control interventions like Indoor Residual Spray (IRS) and usage of insecticide treated nets. Community mobilization strategies were imparted through specially tailored education material like calendars, flipbooks, posters, etc. While supplementing malaria elimination programme in Mandla, the MEDP also contributed to control efforts of the state for dengue and chikungunya. MEDP extensively participated in the community mobilization in creating awareness among the public about possible breeding places of aedes vector, preventive measures, and case management etc. Along with vector-borne infections, tracking of respiratory illness during the Covid-19 pandemic was also supported.²⁷

The project interventions resulted in ~91% reduction in indigenous malaria cases in Mandla. The prevalence of asymptomatic cases too reduced in mass surveys from 0.18% (Sept.–Oct 2018) to 0.03% (December 2019). Mass screening and treatment were undertaken thrice a year covering pre, during, and post-transmission seasons which led to the resolution of the reservoirs of infection. The study demonstrated a successful model of rapid and sustainable decline in

malaria based on real-life settings of a highly malaria-endemic district.^{28,29}

This project showed that the programmatic interventions such as case management and vector control with contextual modifications can lead to significant malaria reduction. The key factors which led to this success were intense hands on training of the grassroot workers and health workers, the movement of the health staff supported by advance tour plans (ATPs), well-equipped field kits, implementation of a digital platform for real time data collection and reporting and managing the supply chain. Other important factors were monitoring of indoor residual spray, insecticide bednet distribution and continuous community awareness programs. Regular weekly and monthly reviews benefited the programme's monitoring and evaluation.

The support of the stakeholders such as state government and NIRTH was also crucial to the success of the MEDP. However, there were several barriers to the successful deployment of various components of MEDP like reluctance to adoption of digital application for data collection and reporting which was overcome by training and motivation. The multiple national programme responsibilities of the front line workers could limit the execution of ATPs and this was resolved by good planning. Quality training and supply chain management were helpful in overcoming several hurdles.²⁸

Since in both demonstration projects mentioned above, there was utilization of the existing programmatic strategies and strengths in the system, these are scalable and replicable by the national programme. The insights on the role of asymptomatic cases in continuous transmission gained from CCMP prompted the Government of Odisha to launch DAMaN to liquidate the asymptomatic case reservoir.

The above two case studies cited and the examples from other countries were able to decline the caseload of malaria. The possible difficulties in transforming this decline to elimination could be a) the selected areas are highly endemic as in Indian cases of Mandla and South Odisha districts – thus the aim was reduction b) the duration of the Indian case studies was limited and malaria elimination to zero indigenous case would have needed more time c) the adjoining districts were highly endemic too and there would have been a possibility of migration of cases/infected vectors. PPPs can tackle the issue of achieving elimination if these have an inbuilt component of sustainability. This needs a commitment from government stakeholders to adopt best practices of these PPP projects till malaria elimination is achieved.

There could be many barriers to a successful collaboration between public and private entities. These could range from different and competing goals and priorities, expectations of resources from each other, expected roles and responsibilities, possible communication gaps, conflicts in ownership of success/failure, lack of transparency in sharing of information, fragmentation

of services, weakened health worker rights, problems in quality of services, affordability, ease of access, existing government services becoming dysfunctional, budgetary constraints, lack of accountability and inefficient systems of monitoring and grievance redressal.

The above can be overcome by systematic planning, clear cut division of roles and responsibilities, strong monitoring, independent reviews, community feedbacks, ownership by state governments and sustainability plans. The examples cited for malaria elimination viz. MEDP and CCMP had a strong component of monitoring and evaluation along with mid-course correction options.

Harnessing public-private partnerships for malaria

The above case studies illustrate the different pathways taken by the organizations which led to a drastic decline in malaria burden and put these malaria endemic areas on the elimination track. These two projects (DAMaN and MEDP) are examples of a holistic addressal of malaria as a problem, where all facets of malaria elimination were covered by selected interventions.²⁹

Both models have their own uses and merits. MEDP followed the programmatic interventions with vigour with additional interventions such as strengthening of surveillance, liquidating asymptomatic infection reservoirs, supervision of vector control activities and use of digital apps. The model is said to be replicable by the state government and might be adopted by the State government of Madhya Pradesh in other malaria endemic districts. CCMP focused on strengthening surveillance in the inaccessible areas and supporting the supply chain and supervision of the grassroot level staff.

India can benefit immensely from the PPP mode of malaria control services. India's malaria burden is heterogeneous and spread >720 districts. As per 2020 national programme data, 23 districts continue to be in category 3 (API > 2), 9 districts in category 2 (API 1-2) and 697 districts in category 1 (API < 1).³⁰ The category 3 and 2 districts are listed in Tables 2 and 3 respectively. The elimination strategies are different for these categories. The challenges to elimination are many ranging from vast inaccessible and hard-to-reach areas, the vulnerable populations including migrants, indigenous tribes, pregnant women and children, significant *P. vivax* malaria burden and risk of relapses, non-inclusion of the private sector, the threat of drug and insecticide resistance, a large reservoir of asymptomatic malaria, neglected Plasmodium species, inadequate access and affordability to vector control tools, diagnostics and treatment. In addition, the national programme has likely a shortage of skilled workforce.³¹ Given the available resources, overcoming the above barriers satisfactorily could be demanding and so these may pose as hurdles in achieving malaria elimination goals by 2030. It is thus pragmatic that the private sector is encouraged

S. No.	State	District	API
1.	Uttar Pradesh	Bareilly	2.22
2.	West Bengal	Kolkata	2.29
3.	Odisha	Koraput	2.38
4.	Chhattisgarh	Kanker	2.87
5.	Uttar Pradesh	Badaun	3.18
6.	Chhattisgarh	Kondagaon	4.17
7.	Tripura	Dhalai Tripura	4.44
8.	Odisha	Phulbani (Kandhamal)	4.5
9.	Chhattisgarh	Nicobar	4.91
10.	Odisha	Rayagada	4.95
11.	Jharkhand	West Singhbhum	5.22
12.	Odisha	Kalahandi	5.66
13.	Mizoram	Saiha	6.16
14.	Meghalaya	South Garo Hills	6.33
15.	Mizoram	Mamit	7.57
16.	Maharashtra	Gadchiroli	7.73
17.	Odisha	Malkangiri	11.59
18.	Chhattisgarh	Sukma	13.99
19.	Chhattisgarh	Narayanpur	17.42
20.	Mizoram	Lunglei	19.83
21.	Chhattisgarh	Dantewada (Sukma, Narayanpur)	20.47
22.	Mizoram	Lawngtlai	24.33
23.	Chhattisgarh	Bijapur	25.32

Table 2: List of high burden malaria endemic districts (Category 3) of India with Annual Parasite Incidence more than 2 in 2020.

Source: National Centre for Vector Borne Diseases Control.

to be actively involved with the Government's malaria elimination programme.

The private actors can be encouraged to contribute in malaria elimination drive of the country by engaging with them at political, technical and logistical levels. Government can proactively seek interest of the companies/private players to address any facet of malaria elimination programme. For instance, any established telecom company can choose to support the community engagement/advocacy intervention

S. No.	States	District	API
1.	Jharkhand	Khunti	1
2.	Odisha	Nawarangpur	1.03
3.	Meghalaya	East Garo Hills	1.13
4.	Tripura	South Tripura	1.15
5.	Jharkhand	Latehar	1.16
6.	Chattisgarh	Gariaband	1.21
7.	Odisha	Boudh	1.32
8.	Madhya Pradesh	Balaghat	1.47
9.	A & N Islands	Nicobar	1.95

Table 3: List of Category 2 malaria endemic districts of India with Annual Parasite Incidence between 1 and 2 in 2020.

Source: National Centre for Vector Borne Diseases Control.

using digital tools, or can assist national programme in developing digital surveillance tools. The companies can undertake these activities under Corporate Social Responsibility. Government agencies can liaison with these companies for fair assessment of the gaps in the current system, and ways to provide fillip to these gaps can be devised.

Encouraged by the above precedents, we propose that similar demonstration projects in selected malaria-endemic areas would be gainful and will provide fillip for malaria elimination.

There are several rationales why this approach of a confluence of public-private organizations would yield favorable outcomes in different malaria endemicity scenarios. These are a) government resources may be limited and may not be sufficient to mount a vigorous and forceful reciprocation to the challenges in some of malaria high endemic areas. The caseload is high and the tools and energy needed to tackle them effectively may be not be available fully and timely with the national programme. These can be infused by private sector actors along with the government partners to bring down the burden to a minimum which can then be taken over by the national programme b) given the heterogeneity of malaria, the same elimination strategies being deployed by the multi-tasking healthcare staff may not give the desired results. There is a need to develop tailored strategies for different endemic regions and for different populations. The skills of the healthcare workers need to be sharpened and adapted to the style and pace of the new interventions like it was done in MEDP and DAMaN c) financial and non-financial investments in developing and testing a new model may be feasible for a private philanthropic organization but not by the government bodies which may be under the pressure of catering to several disease programmes many of which are under elimination phase such as visceral leishmaniasis and lymphatic filariasis d) private sector organizations can bring quality expertise like data analytics, well-structured public resources management like modernization of supply chain management, modern technologies like deployment of mobile app, minimize unforeseen additional costs, provide employment opportunities and enable timely completion e) convergence of private and public sector greatly enhances communities' trust in the system and they are inclined to adopt the practices being promoted in the programme.

Possible role for public-private partnership

A two-pronged approach can be considered in fostering and building PPPs in the malaria elimination space:

Demonstration projects covering all facets of malaria elimination

The public-private partnerships can be envisaged in multiple contexts targeting malaria elimination in India. Various private partners can select any specific

facet of the national programme according to the available resources and in alignment with their own organizational goals. Accordingly, following programmatic components can be augmented by PPPs:

- a) Surveillance: prompt case detection by active and passive surveillance has been considered a key intervention. The success of the national programme relies heavily on the robustness and completeness of the surveillance in the susceptible communities. Private partners can bolster the surveillance component by providing additional trained workforce, especially in the difficult to access areas (for example in CCMP²¹). Strengthening the supply chains via provision of rapid diagnostics can also be a major boost in supplementing the timely diagnosis. Real time data collection and transfer like the SOCH application developed in the MEDP would be of great assistance.²⁸ Developing digital dashboards for near real time data transfer and data visualization for evidence-backed action would enable higher efficiency in the surveillance system.³² Expertise and resources of private organizations with the technical knowhow and field knowledge can also be leveraged. For example, the Kala Azar management Information System (KAMIS) has been developed by CARE and is in use by the national programme and other partners for data analysis.³³ The Tata Trusts' South Odisha Initiative with the state government aimed at routine surveillance screening through mass surveys and door to door surveillance, vector control via residual sprays, supply of mosquito nets and related assistance.³⁴
- b) Case management: The diagnosis and treatment of patients by healthcare workers is a key component in breaking the transmission cycle. This also facilitates better recovery from disease. Private health care facilities can play a major role in this aspect. They can contribute to the disease burden estimation exercise of the government via reporting of detected malaria cases. They can also provide quality care according to the norms of the national guidelines. The MEDP and CCMP had the component of malaria treatment via the national healthcare system using the healthcare workers. MMV is an example of involvement of not-for-profit organization for research and development of new antimalarial drugs for case management.
- c) Vector control: This arm of the national programme primarily comprises of insecticide bednets distribution through international donation and partial domestic funding, and indoor residual spray routines. The Global Fund to Fight AIDS, Tuberculosis, and Malaria financially supports the purchase and distribution of long lasting insecticide impregnated nets in India. Non-government partners like

Tata Trusts, PATH, CARE, Sun Pharma (MEDP) can adopt the responsibility of supervision and monitoring of indoor residual spray of insecticides to kill the adult vectors.³⁵ In some instances, pumps, staff and training component are already provided by the private partners.

- d) Community mobilization: This is a very crucial component of the national programme wherein active participation and involvement of communities is sought. The vulnerable section of society such as indigenous population, women and children, and migrants may not be fully covered by the national programme due to logistical issues. Both MEDP and CCMP had strong activities in this sector. Social organizations, civil society like the Red Cross, professional bodies like Indian Medical Association can contribute via consultation and devise strategies for enhanced coverage.

However, these demonstration projects should have an element of sustainability with the existing government resources. This is to ensure continuity of the benefits of the new strategies and/or tools even when the private organization pulls out of the area after completion of the demonstration project. To address the important issue of sustainability, involvement of the public health programme from the inception of the demonstration project and actual implementation of the project is of utmost importance. Ownership and upliftment of the skills of the existing staff are collateral benefits of such an exercise. Usually, these demonstration projects would bolster the entire malaria control programme ecosystem (eg. supply chains, surveillance, and reporting system) and it is important to ensure the sustenance of the upgraded system after the departure of the private actor. In addition to high endemic areas, which are the obvious choices for such demonstration projects, areas with low endemicities but in need of a final push to deliver these areas to the brink of elimination may be considered. Vulnerable populations such as migrants and laborers, and indigenous populations with peculiar practices enhancing their exposure to malaria and reducing the effectiveness of vector control tools such as jhum cultivation (slash and burn) need special attention. Organizations and high net value individuals can be approached to support such programme in a not-for-profit, philanthropic way. The high burden districts belonging to categories 3 and 2 can be prioritized for such malaria elimination demonstration projects.

Projects supporting some specific elements of the national programme

Out of the multiple components of the national programme, private companies with niche expertise can choose to buttress certain aspects as this would propel the performance of that particular facet. There are examples of other vector-borne diseases where private bodies have addressed a particular aspect of the national

programme. For, eg. CARE-India supported monitoring quality and method of indoor residual spray for visceral leishmaniasis elimination programme and some other components,³⁵ and PATH-India supported the component of ensuring compliance to drugs in mass drug administration for the lymphatic filariasis elimination programme.³⁶ It is acknowledged that such PPP projects focusing on individual aspects of malaria elimination activities would benefit the overall malaria elimination programme to a certain limit only as one or few aspects would be given a thrust and their positive impact would get diluted in the myriad of other components which may be under-performing. However, the benefit of such individual component projects lies in the fact that these projects would not be as resource intensive as the holistic elimination demonstration projects, and more and more private actors can be invited to participate in these. Also, sustainability of the tools/strategies is more likely than in the overarching demonstration projects.

Conclusions

Irrespective of the kind of public-private partnership that is envisaged, planned and executed, it would undeniably benefit malaria-affected communities. The odds of achieving the national goal of malaria elimination by 2030 would be better with public and private actors working in sync. We had earlier proposed integration and convergence of different stakeholders to reach the goalpost of malaria elimination.³⁷ New vision, methods, tools, strategies and activities may be needed to propel the country towards elimination. Disruptive methods such as multiple public-private associations and breaking down the barriers between the two sectors are expediently needed. The control programme may consider actively calling for expressions of interest by the private sector with due credentials to cooperate, support, and co-execute the malaria elimination activities in line with the malaria programme to deliver the much-coveted success in a replicable and sustainable manner.

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AS conceptualized the idea, MR reviewed the literature and drafted the manuscript, AS & MR edited and approved the manuscript.

Declaration of interests

The authors declare no conflict of interests.

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